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LIQUID CRYSTAL DISPLAY AND ITS MANUFACTURING METHOD

[Abstract]

PROBLEM TO BE SOLVED: To reduce display unevenness in the vicinity of a panel peripheral part in a constitution, where columnar spacers are formed on the outside of a display area.

SOLUTION: A liquid crystal display device is provided with an array substrate 11a, having pixel electrodes 8 and switching active elements 3 for driving the pixel electrodes 8, a color filter substrate 1a which has counter electrodes 10 to the pixel electrodes 8 on a pattern of colored films 6 and a light-shielding film 4, and columnar spacers 5 which are formed on the color

filter substrate 1a with a prescribed pattern form, a prescribed height, and a prescribed density. A liquid crystal is sealed in the gap between the array substrate 11a and the color filter substrate 1a, and the columnar spacers 5 formed on the outside 17a of the display area on the color filter substrate 1a are provided on at least one colored film 6 and a light-shielding film 4. Thus the same film constitution is given to the outside 7a of the display area and the inside 17a of the display area, and gap unevenness will not occur in the vicinity of the panel periphery, because a difference in height between the inside and the outside of the display area will not occur.

[Claims]

[Claim 1]

A liquid crystal display (LCD) device comprising an array substrate having a pixel electrode and a switching active device for driving the pixel electrode, a color filter substrate having a counter electrode of the pixel electrode on a pattern of a coloration film and a light blocking film, columnar spacers with a certain pattern and certain height formed with certain density on the color filter substrate, and liquid crystals sealed in a gap between the array substrate and the color filter substrate, wherein the columnar spacers formed on a non-display region of the color filter substrate are formed on the coloration film and the light blocking film of at least one or more colors.

[Claim 2]

A liquid crystal display (LCD) device comprising a color filter on an array substrate having a coloration film and a resin film pattern on a pixel electrode and a switching active device for driving the pixel electrode, a counter substrate having a counter electrode of the pixel electrode, columnar spacers with a certain pattern and height and density formed on the color filter on the array substrate, and liquid crystals sealed in a gap between the color filter on the array substrate and the counter substrate, wherein the columnar spacers formed on a non-display region of the color filter on the array substrate are stacked on the coloration film and the resin film of at least one or more colors.

[Claim 3]

The LCD device as recited in claim 2 including: an ITO electrode formation substrate having a pixel electrode formed in a desired pattern, a color filter substrate having a counter electrode of the pixel electrode on a pattern of a coloration film and a light blocking film and a resin film, and columnar spacers with a certain pattern and height and density formed on the color filter substrate, and liquid crystals sealed in a gap between the ITO electrode formation substrate and the color filter substrate, wherein the columnar spacers formed on a non-display region of the color filter substrate are stacked on the coloration film, the light blocking film and the resin film of at least one or more colors.

[Claim 4]

A method for fabricating an LCD device comprising: forming a pattern of a coloration film and a light blocking film on one substrate of two facing substrates and forming columnar spacers on the pattern; and bonding the columnar-spacers-formed substrate and the other substrate, wherein the light blocking film is formed on a non-display region of one substrate, and at the same time, the coloration film of one or more colors is stacked on the light blocking film, on which the columnar spacers are formed.

[Claim 5]

A method for fabricating an LCD device comprising: forming a pattern of a coloration film and a resin film on one substrate of two facing substrates and forming columnar spacers on the pattern; and bonding the

columnar-spacers-formed substrate and the other substrate, wherein the coloration film of one or more colors is formed on a non-display region of one substrate, and at the same time, the resin film is stacked on the coloration film, on which the columnar spacers are formed.

[Claim 6]

A method for fabricating an LCD device comprising: forming a pattern of a coloration film, a light blocking film and a resin film on one substrate of two facing substrates and forming columnar spacers on the pattern; and bonding the columnar-spacers-formed substrate and the other substrate, wherein the light blocking film is formed on a non-display region of one substrate, and at the same time, the coloration film of one or more colors and the resin film are stacked on the light blocking film, on which the columnar spacers are formed.

[Title of the Invention]

LIQUID CRYSTAL DISPLAY DEVICE AND FABRICATION METHOD THEREOF

[Detailed description of the Invention]

[Field of the Invention]

The present invention relates to a liquid crystal display (LCD) device and its fabrication method and, more particularly, to an LCD device including a color filter substrate with columnar spacer formed thereon which is capable of enhancing display quality and a production yield.

[Description of the Prior Art]

Figure 8 shows a sectional construction view of a TFT type LCD device (referred to hereinafter as 'liquid crystal panel') in accordance with a related art thin film transistor. The TFT type liquid crystal panel 31f includes an array substrate 11f and a color filter substrate 1f.

The color substrate 1f includes a glass substrate 2a, a light blocking film formed on the glass substrate 2a, a color filter consisting of R, G and B coloration films 6R, 6G and 6B (not shown), and a transparent electrode 10.

The array substrate 11f includes a glass substrate 2b, active devices 3a and 3b each consisting of a signal line and a scan line formed on the glass substrate 2b, and a pixel electrode 8.

Alignment films 9a and 9b are formed at both facing surfaces of the color filter substrate 1f and the array substrate 11f. Liquid crystal 14 is charged in the gap with spherical spacers 15 between the substrates 1f and 11f, and a sealing material 13 is fixed at its edge portion. A polarization plate can be attached on the surface of the panel according to a purpose of the liquid crystal panel 31f.

The related art TFT liquid crystal panel 31f has many problems to be solved.

First, precision of the gap between the array substrate 11f and the color filter substrate 1f is a critical factor for determining a display quality. Namely, if the gap is not uniform on the panel surface, a spot is created on the surface, and if a panel gap is different from a designed value, panel characteristics such as contrast is degraded.

Second, when black color is displayed by applying a voltage to the

panel, light leakage occurs due to the spherical spacer 15 positioned between a light blocking film 4 of a pixel, among the spherical spacers 15 inserted between the array substrate 11f and the color filter substrate 1f, and density of the black color display deteriorates. Namely, contrast with white color display deteriorates.

Third, in case of form the panel, the spherical spacers 15 spread on the substrate through a wet or dry method. When the spacers 15 spread, coagulation of spacers or introduction of a foreign material can occur to cause a spot deficiency portion can be generated on the panel. Namely, the yield of the panel process deteriorates due to the spot deficiency portion.

For those reasons, recently, a method for forming the columnar spacers on the substrate in advance has been proposed, instead of forming the spherical spacers 15 according to the related art spreading method.

However, in the newly proposed method using the columnar spacers, the columnar spacers must spread entirely on the glass substrate as well as at a display region (except for a seal pattern), likewise in the related art where the spherical spacers spread.

In other words, if the columnar spacers spread only at the display region, as shown in Figure 9b, a non-display portion 17e is attached by a pressing force applied in an up/down direction of substrates 1e and 11e during a bonding process of a panel assembly process. Then, a gap 12f near a seal 13 of the display region 7e inside the seal 13 increases, and in this state, the seal hardens as it is, causing a display blot generated near the panel periphery portion 18e.

In an effort to solve such a problem, as shown in Figure 9a, columnar

spacers 5 spread also at a non-display region 17d, forming the columnar spacers entirely on the substrate 1d, so that although a pressure is applied to substrates 1d and 11d up and down during a bonding process of the panel assembly process, the substrates are not deformed over the entire area of the non-display region 17d and a display region 7d, and a uniform gap can be formed also near the panel periphery portion 18d, thereby improving display quality.

[Problems to be solved by the Invention]

Formation of the columnar spacers on the non-display region can enhance the display quality near the panel periphery portion, but since film construction inside and outside the display region is different, a step occurs between both regions and thus the display blot of the panel peripheral portion cannot be completely removed.

In other words, the display region includes a switching active device 3, a light blocking film 4, a coloration film 6 and a columnar spacer 5 while the non-display region includes only the columnar spacer 5, causing a step difference therebetween. Thus, when pressure is applied to the substrates in the up/down direction during the bonding process of the panel assembly process, since the non-display region 17d is somewhat low, a gap of a portion 12d of the display region 7d near and inside the seal increases, and in this state, seal hardens, causing a display blot near the penal peripheral portion.

Therefore, an object of the present invention is to provide a liquid crystal display (LCD) device and its fabrication method capable of reducing

a step between both display region and non-display region according to different film construction and preventing generation of a blot near a panel peripheral portion in constructing columnar spacers on the non-display region.

[Means for solving the problem]

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, there is provided a liquid crystal display (LCD) device as recited in claim 1 of the present invention including: an array substrate having a pixel electrode and a switching active device for driving the pixel electrode, a color filter substrate having a counter electrode of the pixel electrode on a patter of a coloration film and a light blocking film, columnar spacers with a certain pattern and certain height formed with certain density on the color filter substrate, and liquid crystal sealed in a gap between the array substrate and the color filter substrate, wherein the columnar spacers formed on a non-display region of the color filter substrate are formed on the coloration film and the light blocking film of at least one or more colors.

Thus, since the columnar spacers formed on the non-display region of the color filter substrate are stacked on the coloration film and the light blocking film of at least one or more colors, film construction on the display region and on the non-display region can be equal, preventing formation of a step between the both regions. In this case, the total thickness of the film of the display region is the sum of the light blocking film, the coloration film, the columnar spacer, the counter electrode and the switching active device,

while the total thickness of the film of the non-display region is the sum of the light blocking film, the coloration film of at least one or more colors and the columnar spacer. That is, the total thickness of the both films is almost the same. Accordingly, in the bonding process of the panel assembly process, gap non-uniformity near the panel peripheral portion does not occur when pressure is applied in the up and down direction of the substrates, and thus, a display blot is not generated.

To achieve the above object, there is also provided an LCD device as recited in claim 2 including: a color filter on array substrate having coloration film and resin film pattern on a pixel electrode and a switching active device for driving the pixel electrode, a counter substrate having a counter electrode of the pixel electrode, columnar spacers with a certain pattern and height and density formed on the color filter on array substrate, and liquid crystal sealed in a gap between the color filter on array substrate and the counter substrate, wherein the columnar spacers formed on a non-display region of the color filter on array substrate are stacked on the coloration film and the resin film of at least one or more colors.

Since the columnar spacers formed on the non-display region of the color filter on array substrate are stacked on the coloration film and the resin film of at least one or more colors, film construction of the display region and the non-display region can be the same without causing a step between both regions. In this case, the total thickness of the film of the display region is the sum of the resin film, the columnar spacer, the counter electrode and the switching active device, while the total thickness of the film of the non-display region is the sum of the coloration film of at least one

or more colors, the resin film and the columnar spacer. That is, the total thickness of the both films is almost the same. Accordingly, in the bonding process of the panel assembly process, gap non-uniformity near the panel peripheral portion does not occur when pressure is applied in the up and down direction of the substrates, and thus, a display blot is not generated.

To achieve the above object, there is also provided an LCD device as recited in claim 3 including: an ITO electrode formation substrate having a pixel electrode formed in a desired pattern, a color filter substrate having a counter electrode of the pixel electrode on a pattern of a coloration film and a light blocking film and a resin film, and columnar spacers with a certain pattern and height and density formed on the color filter substrate, and liquid crystal sealed in a gap between the ITO electrode formation substrate and the color filter substrate, wherein the columnar spacers formed on a non-display region of the color filter substrate are stacked on the coloration film, the light blocking film and the resin film of at least one or more colors.

Since the columnar spacers formed on the non-display region of the color filter on array substrate are stacked on the coloration film and the resin film of at least one or more colors, film construction of the display region and the non-display region can be the same without causing a step between both regions. In this case, the total thickness of the film of the display region is the sum of the light blocking film, the coloration film, the resin film, the columnar spacer and the pixel electrode, while the total thickness of the film of the non-display region is the sum of the light blocking film, the coloration film of at least one or more colors, the resin film and the columnar spacer. That is, the total thickness of the both films is

almost the same. Accordingly, in the bonding process of the panel assembly process, gap non-uniformity near the panel peripheral portion does not occur when pressure is applied in the up and down direction of the substrates, and thus, a display blot is not generated.

To achieve the above object, there is also provided a method for fabricating an LCD device as recited in claim 4 including: forming a pattern of a coloration film and a light blocking film on one substrate of two facing substrates and forming columnar spacers on the pattern; and bonding the columnar spacers-formed substrate and the other substrate, wherein the light blocking film is formed on a non-display region of one substrate, and at the same time, the coloration film of one or more colors is stacked on the light blocking film, on which the columnar spacers are formed.

Since the light blocking film is formed on the non-display region of one substrate and at the same time the coloration film of one or more colors is stacked on the light blocking film, on which the columnar spacer is formed, film construction of the display region and the non-display region can be the same without causing a step between both regions. Accordingly, in the bonding process of the panel assembly process, gap non-uniformity near the panel peripheral portion does not occur when pressure is applied in the up and down direction of the substrates, and thus, a display blot is not generated.

To achieve the above object, there is also provided a method for fabricating an LCD device as recited in claim 5 including: forming a pattern of a coloration film and a resin film on one substrate of two facing substrates and forming columnar spacers on the pattern; and bonding the

columnar spacers-formed substrate and the other substrate, wherein the coloration film of one or more colors is formed on a non-display region of one substrate, and at the same time, the resin film is stacked on the coloration film, on which the columnar spacers are formed.

Since the coloration film of one or more colors is formed on the non-display region of one substrate and at the same time the resin film is stacked on the coloration film, on which the columnar spacer is formed, film construction of the display region and the non-display region can be the same without causing a step between both regions. Accordingly, in the bonding process of the panel assembly process, gap non-uniformity near the panel peripheral portion does not occur when pressure is applied in the up and down direction of the substrates, and thus, a display blot is not generated.

To achieve the above object, there is also provided a method for fabricating an LCD device as recited in claim 6 including: forming a pattern of a coloration film, a light blocking film and a resin film on one substrate of two facing substrates and forming columnar spacers on the pattern; and bonding the columnar spacers-formed substrate and the other substrate, wherein the light blocking film is formed on a non-display region of one substrate, and at the same time, the coloration film of one or more colors and the resin film are stacked on the light blocking film, on which the columnar spacers are formed.

Since the light blocking film is formed on the non-display region of one substrate and at the same time the coloration film of one or more colors and the resin film are stacked on the light blocking film, on which the

columnar spacers are formed, film construction of the display region and the non-display region can be the same without causing a step between both regions. Accordingly, in the bonding process of the panel assembly process, gap non-uniformity near the panel peripheral portion does not occur when pressure is applied in the up and down direction of the substrates, and thus, a display blot is not generated.

[Embodiment of the invention]

The first embodiment of the present invention will now be described with reference to Figures 1 and 2. Figure 1 is a schematic sectional view at a point when pressure is applied to the columnar spacer color filter substrate 1a and the array substrate 11a in an up/down direction after bonding them.

With reference to Figure 1, the LCD device includes an array substrate 11a having a pixel electrode 8 and a switching active device 3 for driving the pixel electrode 8, a color filter substrate 1a having a counter electrode 10 of the pixel electrode 8 formed on a coloration film 6 and a light blocking film 4, columnar spacers 5 formed with a certain pattern, height and density on the color filter substrate 1a, and liquid crystal sealed in a gap between the array substrate 11a and the color filter substrate 1a, wherein the columnar spacers 5 are stacked on the coloration film 6 and the light blocking film 4 of at least one or more colors at a non-display region of the color filter substrate 1a.

A method for fabricating the LCD device will now be described. Figure 2 is a sectional view showing a process of the columnar spacer color filter substrate 1a of a method for fabricating the LCD device in accordance

with the first embodiment of the present invention.

First, as shown in Figure 2a, a light blocking layer is formed on a glass substrate 2a and a light blocking film in a desired pattern is patterned by a general photolithography.

As for the light blocking film 4, a resin film or a chrome film can be discriminately used, but in this case, a 0.1μm chrome film is used as an example. A light blocking film 4 is patterned at a desired position on the non-display region 17a.

With reference to Figure 2b, a pigment resistor is coated on the RGB coloration films 6 (6R, 6G, 6B), which is then exposed and developed to form a certain pattern. A spinner coating condition is set so as for the coloration film 6 to have a thickness of 1.5μm after it is completely formed. As for the non-display region 17a, an exposure mask is designed such that a desired pattern of the coloration films 6R and 6G can overlap on the first formed light blocking film 4, and the RGB coloration film 6 (6R,6G, 6B) is stacked as two layers in the display region 7a.

Next, as shown in Figure 2c, with a metal mask set on the substrate, a desired transparent electrode 10 of ITO is formed by using an ITO spatter unit.

Finally, as shown in Figure 2d, a resin film is coated by using a spinner and then exposed to form columnar spacers 5. In the display region 7a, the columnar spacers 5 are formed on a gate line of the black matrix where the coloration film 6 is formed on the light blocking film 4, and in the non-display region 17a, the columnar spacers are formed on the portion where the light blocking film 4 and the pattern of the coloration film 6R and

5G are stacked. The height of the columnar space can be determined according to designing of a cell gap of the panel, and in this embodiment, it is designed to be 5μ.

As shown in Figure 1, when the columnar spacer color filter substrate 1a with the above-described film construction and the array substrate 11a are bonded by a sealing material 13 through a panel process, the total thickness of the film in the display region is 6.6μm obtained by adding 0.1μm of the light blocking film 4, 1.5μm of the coloration film 6, 3.5μm of the columnar spacer 5, 0.1μm of the ITO transparent electrode 10, 0.1μm of the alignment film 9a, of the color filter substrate side, and 1.3μm of the switching active device 3, 0.1μm of the alignment 9b of the array substrate side. Meanwhile, the total thickness of the film in the non-display region is 6.6μm obtained by adding 0.1μm of the light blocking layer 4, 3.0μm of the sum of the two-layer coloration film 6R and 6G, and 3.5μm of the columnar spacer. That is, because the film thickness of both sides is almost the same, there is little deformation of the substrate and a uniform gap can be formed even at the panel periphery portion 18a. Thus, the uniform gap can be formed over the entire display region and the substrate can have good display quality. A fabricated TFT LCD device can have a panel gap with 4.7μm obtained by subtracting 0.1μm of the pixel electrode 8 from the sum of the 3.5μm of the columnar spacer 5 and 1.3μm of the switching active device.

The second embodiment of the present invention will now be described with reference to Figures 3 to 5. Figure 3 is a schematic sectional view at a point when pressure is applied in an up/down direction to a columnar spacer color filter on array substrate 11b and an ITO-processed

counter substrate 1b as bonded in a panel process of an LCD device in accordance with the second embodiment of the present invention.

As shown in Figure 3, the LCD device includes the color filter on array substrate 11b having a pattern of the coloration film 6 and the resin film 16 on the pixel electrode 8 and the switching active device 3 for driving the pixel electrode 8. The LCD device also includes the columnar spacers 5 with a certain pattern, height and density formed thereon, and liquid crystal id sealed in a gap between the color filter on array substrate 11b and the counter substrate 1b having a counter electrode 10 of the pixel electrode 8, and in this case, the columnar spacers 5 are stacked on the coloration film 6 and the resin film 16 of at least one or more colors on the non-display region 17b of the color filter on array substrate 11b.

A method for fabricating the LCD device will now be described. Figures 4 and 5 are sectional view of a process of the columnar spacer color filter substrate 11b in fabrication the LCD device in accordance with the second embodiment of the present invention.

As shown in Figure 4a, in forming the color filter-formed array substrate 11b, the switching active device 3 is formed on the glass substrate 2b by repeatedly forming a general semiconductor thin film and an insulation film and performing etching by the general photolithography method.

Next, as shown in Figure 4b, a black resistor with an organic pigment dispersed is coated on the glass substrate 2b with the active device 3 formed thereon, and the light blocking film 4 is formed on the required (desired) patterns by using the photolithography method. As an exposing

device used for the photolithography, a proximity exposing device is quite suitable. Or, in order to enhance precision of patterning, a miller projection exposing device can be used. Preferably, the black has material characteristics of a resistance rate of above 10 12 ohm/cm, a dielectric constant of below 4 and an OD value of above 2.5 after its formation. The spinner condition was set such that the light blocking film 4 has a thickness of 1.5μm.

Next, as shown in Figure 4c, a pigment-dispersed photosensitive resin 6R is formed on the resulting structure, which is then exposed and developed to form the pigment-dispersed photosensitive resin 6R in a desired (required) pattern, and a contact hole is also formed.

The process is repeatedly performed on the three colors to form RGB coloration film 6 (6R, 6G, 6B). A spinner coating condition was set such that the coloration film 6 has a thickness of 1.5μm when it is completed.

At the non-display region 17b, an exposure mask is designed to form a desired pattern of the coloration film 6R, and then, the coloration film 6 is formed at a portion on which the columnar spacer is to be formed simultaneously when the RGB coloration film 6 (6R,6G,6B) at the in the display region 7b is formed.

And then, as shown in Figure 5d, after a planarization film 16 is formed, a contact hole is formed. Preferably, the planarization film 16 is formed as an acrylic photosensitive type resin. The planarization film 16 is stacked at the non-display region 17b when the planarization 16 is formed at the display region 7b.

Thereafter, as shown in Figure 5e, a transparent electrode is formed

on the entire surface by an ITO spatter, on which the pixel electrode 8 is patterned by the photolithography, whereby the pixel electrode 8 with the thickness of 0.1μm can be formed to be electrically conducted with the active device 3 with the contact hole interposed therebetween.

Finally, as shown in Figure 5f, a resin film is coated by using the spinner, and then, exposed and developed to form the columnar spacers 5. At the display region 7b, the coloration film 6 is stacked on the light blocking film 4 to form the columnar spacer 5 on the gate line of the black matrix, while at the non-display region 17b, the columnar spacer 5 is formed on the portion where the pattern of the planarization film 16 is stacked on the coloration film 6. The height of the columnar spacer 5 can be determined according to designing of a cell gap of the panel, and in this embodiment, the columnar spacer 5 has a height of 8μm. In this manner, the columnar spacer 5 is formed at the color filter on array substrate 11b.

As shown in Figure 3, when the columnar spacer color filter substrate 1a with the above-described film construction and the array substrate 11a are bonded by a sealing material 13 through a panel process, the total thickness of the film in the display region is 6.6μm obtained by adding 0.1μm of the light blocking film 4, 1.5μm of the coloration film 6, 3.5μm of the columnar spacer 5, 0.1μm of the ITO transparent electrode 10, 0.1μm of the alignment film 9a, of the color filter substrate side and 1.3μm of the switching active device 3, 0.1μm of the alignment 9b of the array substrate side. Meanwhile, the total thickness of the film in the non-display region is 6.6μm obtained by adding 0.1μm of the light blocking layer 4, 3.0μm of the sum of the two-layer coloration film 6R and 6G, and 3.5μm of the

columnar spacer. That is, because the film thickness of both sides is almost the same, there is little deformation of the substrate and a uniform gap can be formed even at the panel periphery portion 18a. Thus, the uniform gap can be formed over the entire display region and the substrate can have good display quality. A fabricated TFT LCD device can have a panel gap with 4.7μm obtained by subtracting 0.1μm of the pixel electrode 8 from the sum of the 3.5μm of the columnar spacer 5 and 1.3μm of the switching active device.

The third embodiment of the present invention will now be described with reference to Figures 6 and 7.

Figure 6 is a schematic sectional view at a point when pressure is applied to a columnar spacer color filter substrate 1c and a counter electrode substrate 21c in an up/down direction after bonding them in a panel process of an LCD device in accordance with a third embodiment of the present invention.

As shown in Figure 6, the LCD device includes an ITO electrode formation substrate 21c having a pixel electrode 8 formed with a desired pattern, a color filter substrate 1c having a counter electrode 10 of the pixel electrode 8 formed on a pattern of a coloration film 6, a light blocking film 4 and a resin film 16, columnar spacers 5 with a certain pattern, height and density formed on the color filter substrate 1c, and liquid crystal sealed in a gap between the ITO electrode formation substrate 21c and the color filter substrate 1c, wherein columnar spacers 5 formed on a non-display region 17c of the color filter substrate 1c are stacked on the coloration film 6 of at least one or more colors, the light blocking film 4 and the resin film 16.

A method for fabricating the LCD device will now be described.

Figure 7 is a sectional view showing a sequential process of the columnar spacer color filter substrate 1c.

First, as shown in Figure 7a, the light blocking layer is formed on a glass substrate 2a and then a light blocking film 4 is patterned in a desired form by a general photolithography.

As the light blocking film 4, a resin film or a chrome film can be discriminately used according to circumstances, and in this embodiment, a 1.0μm pigment-dispersed resistor film is used. Also, a pattern of the light blocking film 4 is formed at a desired position of the non-display region 17c.

Next, as shown in Figure 7b, a pigment resistor is coated on the RGB coloration film 6 (6R,6G,6B), exposed and developed to form a certain pattern. A spinner coating condition was set such that the coloration film 6 can have a thickness of 1.5μm after its completion. Meanwhile, as for the non-display region 17c, an exposure mask is designed such that a desired pattern of the coloration films 6R can overlap on the first formed light blocking film 4, and the RGB coloration film 6 (6R,6G, 6B) is stacked when the RGB coloration film 6 (6R,6G,6B) is formed in the display region 7c.

And then, as shown in Figure 7c, a planarization film 16 is formed and a step of the coloration film 6 is leveled. An acrylic resin is quite suitable for the planarization film 16. In this case, the planarization film was coated under the condition of 2μm by using the spinner, but owing to the leveling effect, the planarization film 16 formed on the coloration film 6 has a thickness of 1.5μm.

Thereafter, as shown in Figure 7d, the TIO transparent electrode 10 of 0.1μm is formed on the substrate by using an ITO spatter device, and a

pattern in a desired form is formed by the lithography method.

Finally, as shown in Figure 7e, the resin film is coated by the spinner and then exposed to form the columnar spacers 5.

In addition, in the display region 7c, the coloration film 6 and the planarization film 16 are sequentially formed on the light blocking film 4, so the columnar spacers are formed on the black matrix, and meanwhile, in the non-display region 17c, the coloration film 6R pattern and the planarization film 16 are sequentially formed on the light blocking film 4, on which the columnar spacers 5 are formed. The height of the columnar spacer 5 can be determined according to designing of a cell gap of the panel, and in this embodiment, it is 5μm.

As shown in Figure 6, when the columnar spacer color filter substrate 1c and the counter substrate 21c are bonded by using the sealing material 13 through a panel process, the total thickness of the film of the display region is 10.9 μm obtained by adding 1.0μm of the light blocking film 4, 1.5 μm of the coloration film 6, 1.5μm of the planarization film 16 on the coloration film, 0.1μm of the ITO transparent electrode 10, 6.5μm of the columnar spacer 5, 0.1μm of the alignment film 9a of the color filter substrate, and 0.1μm of the pixel electrode 8, 0.1 μm of the alignment film 9b of the counter substrate 21c. Meanwhile, the total thickness of the film of the non-display region is 10.5μm obtained by adding 1.0μm of the light blocking film 4, 1.5μm of the coloration film 6R, 1.5μm of the planarization film 16 on the coloration film, 6.5μm of the columnar spacer 5.

That is, because the film thickness of both sides is almost the same, there is little deformation of the substrate and a uniform gap can be formed

even at the panel periphery portion 18c. Thus, the uniform gap can be formed over the entire display region and the substrate can have good display quality. A fabricated STN type LCD device can have a panel gap with 6.4μm obtained by subtracting 0.1μm of the pixel electrode 8 from 6.5μm of the columnar spacer 5.

[Effect of the invention]

According to the LCD device as recited in claim 1 of the present invention, because the columnar spaces formed at the non-display region on the color filter substrate are stacked on the coloration film and the light blocking film of at least one or more colors, the film construction on the display region and the non-display region can be the same without causing a step between both regions. In this case, the total film thickness of the display region is the sum of the thickness of the light blocking film, the coloration film, the columnar spacer, the counter electrode and the switching active device, while the total film thickness of the non-display region is the sum of the thickness of the light blocking film, the coloration film of at least one or more colors, and the columnar spacer. The both sides of total film thickness are almost the same. Thus, gap non-uniformity does not occur near the panel according to pressing in the up/down direction of the substrates in the bonding process of the panel assembly process, so a display blot does is not generated.

In addition, by virtue of the columnar spacers, the spot deficiency due to coagulation of the spherical spacers as in the related art LCD device with the spherical spacers, degradation of contrast caused by light leakage

due to the spherical spacers, and gap non-uniformity due to non-uniform spreading of spherical spacers can be enhanced.

According to the LCD device as recited in claim 2, since the columnar spacers formed on the non-display region of the color filter on array substrate are stacked on the coloration film of at least one or more colors and the resin film, the film construction at the display region and at the non-display region can be the same without causing a step between both regions. In this case, the total film thickness of the display region is the sum of thickness of the resin film, the columnar spacer, the counter electrode and the switching active device, while the total film thickness of the non-display region is the sum of thickness of the coloration film of at least one or more colors, the resin film and the columnar space. The both sides of total film thickness are almost the same. Thus, gap non-uniformity does not occur near the panel according to pressing in the up/down direction of the substrates in the bonding process of the panel assembly process, so a display blot does is not generated.

According to the LCD device as recited in claim 3, since the columnar spacers formed at the non-display region of the color filter substrate are formed on the coloration film of at least one or more colors, the light blocking film and the resin film, the film construction at the display region and at the non-display region can be the same without causing a step between both regions. In this case, the total film thickness of the display region is the sum of thickness of the light blocking film, the coloration film, the resin film, the columnar spacer and the pixel electrode, while the total film thickness of the non-display region is the sum of thickness of the light

blocking film, the coloration film of at least one or more colors, the resin film and the columnar space. The both sides of total film thickness are almost the same. Thus, gap non-uniformity does not occur near the panel according to pressing in the up/down direction of the substrates in the bonding process of the panel assembly process, so a display blot does is not generated.

In addition, the problem of the related art LCD device with the spherical spacers can be solved by virtue of the columnar spacers as those in claim 1.

According to the method for fabricating an LCD device as recited in claim 4, immediately when the light blocking film is formed on the non-display region of one substrate, the coloration film of at least one or more colors is stacked on the light blocking film, on which the columnar spacers are formed, whereby the film construction at the display region and at the non-display region can be the same without causing a step between both regions. Thus, gap non-uniformity does not occur near the panel according to pressing in the up/down direction of the substrates in the bonding process of the panel assembly process, so a display blot does is not generated.

According to the method for fabricating an LCD device as recited in claim 5, immediately when the coloration film of at least one or more colors are formed on the non-display region of one substrate, the resin film is stacked on the light blocking film, on which the columnar spacers are formed, whereby the film construction at the display region and at the non-display region can be the same without causing a step between both regions.

Thus, gap non-uniformity does not occur near the panel according to pressing in the up/down direction of the substrates in the bonding process of the panel assembly process, so a display blot does is not generated.

According to the method for fabricating an LCD device as recited in claim 6, immediately when the light blocking film is formed on the non-display region of one substrate, the coloration film of at least one or more colors and the resin film are stacked on the light blocking film, on which the columnar spacers are formed, whereby the film construction at the display region and at the non-display region can be the same without causing a step between both regions. Thus, gap non-uniformity does not occur near the panel according to pressing in the up/down direction of the substrates in the bonding process of the panel assembly process, so a display blot does is not generated.

[Description of drawings]

Figure 1 is a sectional view of an LCD device in accordance with a first embodiment of the present invention;

Figures 2A to 2D are sequential sectional views of a process of the LCD device in accordance with the first embodiment of the present invention;

Figure 3 is a sectional view of an LCD device in accordance with a second embodiment of the present invention;

Figures 4A to 4C are sequential sectional views of a process of the LCD device in accordance with the second embodiment of the present invention;

Figures 5D to 5F are sequential sectional views of a process after the process of Figure 4;

Figure 6 is a sectional view of an LCD device in accordance with a third embodiment of the present invention;

Figures 7A to 7D are sequential sectional views of a process of the LCD device in accordance with the third embodiment of the present invention;

Figure 8 is a sectional view of an LCD device in accordance with a conventional art; and

Figures 9A and 9B show problems of the LCD device in accordance with the conventional art